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REVIEW
of the official reviewer for dissertation work
Serikbolova Albina Askarovna on the theme « Branes and monopoles in modified gravities and Yang-Mills theories»
presented for the degree of Doctor of Philosophy (PhD) in the specialty «8D05306-Physics».

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№	Criteria	Eligibility (one of the options must be checked)	Justification of the position of the official reviewer
1.	The topic of the thesis (as of the date of its approval) corresponds to the directions of development of science and/or state programs	1.1 Compliance with priority areas of science development or government programs:	Results of the study presented in the thesis by Serikbolova A.A. are compliant with the priority areas of science.
		1) The thesis was completed within the framework of a project or target program financed from the state budget (indicate the name and number of the project or program) 2) The thesis was completed within the framework of another state program (indicate the name of the program) 3) The dissertation corresponds to the priority direction of the development of science, approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan (indicate the direction)	Dissertation of Serikbolova A.A. corresponds to the priority direction of development of science "Scientific research in the field of natural sciences", according to the sub-priority «Fundamental and applied research in the field of physics and astronomy". This work was supported by the Program № BR10965191 (Complex Research in Nuclear and Radiation Physics, High Energy Physics and Cosmology for the Development of Competitive Technologies) of the Ministry of Education and Science of the Republic of Kazakhstan.
2.	Importance for science	The work makes a significant contribution to science, and its importance is well disclosed	Results presented in the thesis have theoretical significance within the corresponding area of research. The importance of obtained results is well disclosed.

3.	The principle of independence	Self-reliance level: 1) High; <u>2) Medium;</u> 3) Low; 4) No independence	I assume a sufficient level of independence of the thesis' studies, which is compliant with the requirements. The results of studies are confirmed by publications in international journals with high impact factors.
4.	The principle of inner unity	4.1 Justification of the relevance of the thesis: 1) <u>Justified;</u> 2) Partially justified; 3) Not justified.	A relevance of thesis' studies is justified by examining some topical issues of modern mathematical physics related to the study of the minimum in the energy spectrum of the hypothetical monopole-like objects with a nonlinear spinor source and objects in multidimensional spacetime - branes - within the framework of the modified theory of gravity. Branes are currently still popular conjectured objects, hence studying their properties is a valid problem. Also, the relevance lies in the study of magnetic monopoles within the framework of the Yang-Mills theory including nonlinear spinor fields and finding the minimum in the energy spectrum of these solutions. The new monopole-like solutions in Yang-Mills SU(2) theory are expected to provide an important step in understanding properties of the magnetic monopole. This and further justifications are supported by the publication of research results in such high-rank

			journals like Physical Review D and Physics Letters B.
		4.2 The content of the thesis reflects the topic of the thesis: 1) Reflects; 2) Partially reflects; 3) Does not reflect	The content of the dissertation reflects the topic of the dissertation. Starting with the introduction, 4 sections and the conclusion, the thesis reflects the content of the obtained results. The dissertation contains 161 list of references, as well as 54 figures and 2 tables.
		4.3. The purpose and objectives correspond to the topic of the thesis: 1) correspond; 2) partially correspond; 3) do not correspond	In the thesis, the author clearly formulated the purpose and objectives of the study, which corresponds to the topic of the dissertation.
		4.4 All sections and provisions of the thesis are logically interconnected: 1) completely interconnected; 2) the interconnection is partial; 3) there is no interconnection	The provisions and all sections of the thesis are interconnected with each other.
		4.5 The new solutions (principles, methods) proposed by the author are reasoned and evaluated in comparison with the known solutions: 1) there is a critical analysis; 2) partial analysis; 3) the analysis does not represent one's own opinions, but quotes from other authors	The main difference between the obtained brane solutions is that they are vacuum-type, in contrast to similar solutions in general relativity. The obtained regular monopole-like solutions within SU(2) Yang-Mills theory containing the doublet of nonlinear spinor fields were also compared with solutions in non-Abelian Proca-Dirac-Higgs theory and with Dirac monopoles and 't Hooft-Polyakov monopole. The basic novelty of the resulting solution is that the presence of a mass gap. All methods are justified, and an analysis of their

			application, in one case or another, is presented.
5.	Scientific novelty principle	5.1 Are the scientific results and provisions new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	The scientific results and provisions to be defended in this thesis are partly new, in particular: a) Vacuum brane solutions in the modified theory of gravity are partially new and have not been explored; b) Monopole-like solutions in SU(2) Yang-Mills theory, which interact with nonlinear spinor field, and the presence of a minimum in the energy spectrum of these solutions are new results.
		5.2 Are the dissertation findings new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	The novelty and originality of research of the thesis rests on these facts: 1. New flat-symmetric solutions in multidimensional modified theories of gravity for branes are obtained; 2. It is demonstrated that the main reason of a minimum's occurrence in the energy spectrum in monopole-like solutions in SU(2) Yang-Mills theory was the presence of a doublet of nonlinear spinor fields; 3. It is shown that Yang-Mills monopole with the source of nonlinear spinor fields differs from the Dirac and 't Hooft-Polyakov monopole. The conclusions of the thesis are well justified from a scientific point of view.
		5.3 Technical, technological, economic or management decisions are new and reasonable:	The obtained results on the basis of numerical calculations are consistent

		1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	with the qualitative study of the obtained differential equations, as well as with studies conducted earlier by other authors. The main conclusions and conclusions of this work are justified.
6.	The validity of the main findings	All main conclusions are/are not based on scientifically significant evidence or well-grounded (for qualitative research and areas of training in the arts and humanities)	Based on the materials of the thesis, 8 published outputs were produced: 2 - publication in Kazakh journals, which are recommended by the Committee for Control in the Field of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan (KKSON MON RK) and 3 articles in journals of foreign countries with high impact factors included in the international information resource Web of Knowledge (Thomson Reuters, USA) and Scopus (Elsevier, the Netherlands); 3 works in the collections of International Scientific Conferences. Moreover, research in the field of monopole solutions was awarded in the Republican competition of research among universities of the Republic of Kazakhstan. This testifies to the validity of the conclusions.
7.	The main provisions for the defense	It is necessary to answer the following questions for each provision separately: 7.1 Is the provition proven? 1) proven; 2) rather proven;	7.1 proven 7.2 No 7.3 yes 7.4 medium (theoretical);

		3) rather not proven; 4) not proven 7.2 Is it trivial? 1) yes; 2) no 7.3 Is it new? 1) yes; 2) no 7.4 Application level: 1) narrow; 2) medium; 3) wide 7.5 Is it proven in the article? 1) yes; 2) no	7.5 yes
8.	The principle of reliability. Reliability of sources and information provided	8.1 Choice of methodology - is justified or the methodology is described in sufficient detail 1) <u>yes;</u> 2) no	The methodology of research is justified and described in detail in the presented thesis.
		8.2 The results of the thesis were obtained using modern methods of scientific research and methods of processing and interpreting data using computer technologies: 1) <u>yes;</u> 2) no	To obtain the results in the thesis, modern scientific research methods were used, with the use of the Wolfram Mathematica and Maple software.
		8.3 Theoretical conclusions, models, identified relationships and patterns have been proven and confirmed by experimental research (for areas of training in pedagogical sciences, the results have been proven on the basis of a pedagogical experiment): 1) <u>yes;</u> 2) no	The research carried out in the thesis is based on previous methods for obtaining regular solutions within the framework of modified theory gravity, as well as monopole solutions in non-Abelian Proca-Dirac-Higgs theory by other authors. Therefore, presented results are theoretical, while their experimental confirmation is still

			pending - which is the existing state of affairs in currently popular mainstream modified theories of gravity in higher dimensions or multidimensional theories of unification of interactions.
		8.4 Important statements are confirmed by references to current and reliable scientific literature	The main statements are confirmed in all sections by using links to the available scientific literature.
		8.5 Used literature sources are sufficient for a literature review	The list of references includes 161 references in English and Russian, among which many recent publications in high-rank journals can be found, which are sufficient for a literary review.
9	Practical value principle	9.1 The thesis has theoretical value: 1) yes; 2) no	The presented thesis is of theoretical importance, it is devoted to one of the currently popular problems of the mathematical theoretical physics.
		9.2 The thesis is of practical importance and there is a high probability of applying the results obtained in practice: 1) yes; 2) no	There exist long-held high hopes of applying the results of the thesis's field of research to the hypothetical objects, such as branes and magnetic monopoles, if those can be found in the future. Although, this situation applies to all currently popular mainstream modified theories of gravity in higher dimensions or multidimensional theories of unification of interactions.
		9.3 Are the practice suggestions new? 1) completely new; 2) partially new (25-75% are new);	Ideas and developments for the practice of dissertation work are partially new.

		3) not new (less than 25% are new)	
10.	The quality of writing and design	Academic writing quality: 1) high; 2) average; 3) below average; 4) low.	The quality of an academic writing is average.

I have two final remarks about the thesis:

1. In the "brane" part of the thesis, author derives solutions with anti-de Sitter (AdS) asymptotics in f(R) theory of gravity. On the other hand, when it comes to the real world, it is usually de Sitter spacetime (dS), which is more favored by observations (for instance, in cosmology). Thus, the author could emphasize the possible applicability area of the AdS-asymptotical solutions, if it makes sense for the thesis.

2. Regarding the "monopole" part (along with its references to superfluidity and Bose-Einstein condensation), it would be interesting to find/study monopole solutions in gravity theories related to the so-called logarithmic superfluids (in the relativistic case, mathematically described by logarithmically nonlinear scalar fields). Because the logarithmic superfluid models are known to be successful in describing laboratory superfluids and Bose-Einstein condensates, their relativistic analogs would be having a clear physical foundations and interpretations. This is still a relatively uncharted area; therefore, it could be a future direction of research.

Though, my remarks are just recommendatory; they do not diminish the analytical quality of the obtained results and the thesis as a whole, and their value to the vast and growing community of experts in general relativity, multi-dimensional theories of gravity and Yang-Mills field theories.

Conclusion on the possibility of awarding the degree of Doctor of Philosophy (PhD), Doctor in profile.

In summary, the thesis by Serikbolova Albina Askarovna, entitled «Branes and monopoles in modified gravities and Yang-Mills theories», has been performed at a proper theoretical scientific level, it is a completed research, its content and design meet the requirements of the Committee for Control in the Field of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan to PhD dissertations, and its author Serikbolova Albina Askarovna deserves to be awarded the degree of Doctor of Philosophy (PhD) in the specialty «8D05306-Physics».

Official Reviewer:

Researcher at the
Institute of Systems Science
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Zloschastiev Kostiantyn